

The process **200** further includes step **208** in which one or more layers of a curable powder coating is applied to a surface or subsurface of the cementitious composite substrate. In certain embodiments, the powder coating may be applied to the surface or the subsurface of a cured (hardened) fiber cement article or it may be applied to uncured fiber cement articles and cured either prior to or coincidentally with hardening the fiber cement article. In one embodiment, the powder coating is applied to the cementitious substrate using a number of solventless-type painting or coating systems through which a finely divided, heat fusible material is deposited on the substrate. The deposit is then fused into a continuous functional or decorative film on the substrate. Representative of these types of processes include flame spraying, fluidized bed, hot flocking, electrostatic spray (ESP) and electrostatic fluidized bed (ESFB). ESFB is a hybrid of fluidized bed and ESP. In a preferred embodiment, an ESP system is used. In another preferred embodiment, a tribocharged gun is used. Tribocharging offers well documented advantages over corona discharge in that tribo-guns require no high voltage supply, obtain better Faraday cage penetration, create less back ionization, achieve a wider range of minimum and especially maximum coating thicknesses, produce smoother and more continuous films, and achieve more consistent overall performance, especially in coating articles of complex configuration.

The triboelectric coating process of certain preferred embodiments of the present invention is particularly effective in situations such as when the substrate is profiled. The grooves and ridges present a particular problem for electrostatic coating processes because of the Faraday effect because the electrical charge generated by friction as the powder flows along the plastic or polymer coated surfaces inside the gun are typically relatively small in comparison with the charge picked up as the powder flows through a corona-discharge cloud. The grooves and sharp edges of such panels are covered very well on a flat line coating apparatus with nozzles arrayed to direct a portion of the powder against them. Such panels as well as flat-surfaced panels are particularly well coated by triboelectric guns on a flat line conveyor having electrically conductive bands around the circumference of the conveyor belt. Apparatus for such coating is disclosed in a series of patents assigned to the Nordson Corporation. These are U.S. Pat. Nos. 4,498,913; 4,590,884; 4,723,505; 4,871,380; 4,910,047; and 5,018,909, which are hereby incorporated by reference in their entirety.

As shown in FIG. 2, the process **200** continues with step **210** in which the powder coating is further processed to achieve a predetermined degree of cure. In certain embodiments, the powder coating may be cured thermally, by radiation, by NIR or by a combination thereof, either simultaneously or in staged sequences. In certain preferred embodiments, the powder coating and the gel-form sealer coating are co-cured at step **210**.

FIG. 3 schematically illustrates a suitable flat powder coating apparatus **300** for applying powder coating to a cementitious article according to a preferred embodiment of the present invention. The apparatus **300** generally includes a conveyor **302** extending through a powder coating booth **304**, wherein a fiber cement article **306** supported and moved by the conveyor belt **302** is coated triboelectrically by a plurality of guns **308** situated adjacent one another and in one or more tiers. In a preferred embodiment, the powder is forced into the guns **308** under about 40 psi pressure while air at about 20 psi is passed into the powder conduits just before the powder passes into the nozzles. The fiber cement article **306** bearing the powder is then conveyed through a curing oven **310** having several heating zones, some of which are heated by IR lamps, others by heat convection, and still others by a combination of those two. The coating and the curing line speeds

may be the same or different, depending on the length of the curing oven. The line speed through the powder application booth **304** may be from about 5 to about 200 feet per minute but preferably from about 20 to about 100 feet per minute.

In some embodiments where conventional thermal curing methods are used to cure the powder, the line speed through the curing oven **310**, may be from about 5 to about 50 feet per minute, depending on the oven temperature, the length of the oven, and the particular coating powder used. The curing temperature may range from about 120° F. up to the decomposition temperature of the powder. It is preferred to maintain the cure temperature within the range of from about 190° F. to about 350° F. and still more preferred to keep the cure temperature between about 250° F. to about 300° F.

More preferably, the powder coating may be cured using NIR radiation. Examples of NIR curing equipment and systems can be those manufactured by Adphos Advanced Photonics Systems AG and are described in U.S. Pat. No. 6,436,485, WO03074193A2, EP1144129B1, DE10106888A1, WO0239039A1, WO0226897A2, DE20105063U1, and WO0124988A1, each of which are incorporated herein in their entirety as references. In a preferred embodiment, the NIR curing system co-cures the powder coating and the underlying sealer. The inventors have found that NIR curing is especially suited to curing powder coatings and indeed other types of coatings such as water or solvent based coatings on cementitious composites. This is in large part because the NIR curing regime does not overheat or dehydrate the cementitious materials such as gypsum or Portland cement. Because NIR curing systems do not utilize combustion sources, they do not generate carbon dioxide and therefore will not carbonate the surface of a cement-containing composite.

The inventor has surprisingly found that the preferred embodiments of the present invention allow cementitious articles such as fiber cement articles, especially those articles with texture, profiles and sharp edges to be effectively and economically coated using powder coating techniques. Moreover, articles so coated are able to better maintain coating integrity and adhesion in various accelerated weathering tests such as EMMAQUA, QUV, ASTM C666, heat rain cycling, freeze thaw cycling and the like. Since the coatings are able to maintain adhesion for a longer period of time, the performance of the composite as a whole is also improved.

Although the foregoing description of the preferred embodiments of the present invention has shown, described and pointed out the fundamental novel features of the invention, it will be understood that various omissions, substitutions, and changes in the form of the detail of the invention as illustrated as well as the uses thereof, may be made by those skilled in the art, without departing from the spirit of the invention. Particularly, it will be appreciated that the preferred embodiments of the invention may manifest itself in other shapes and configurations as appropriate for the end use of the article made thereby.

What is claimed is:

1. A cementitious composite article, comprising
  - a cementitious substrate having a first surface;
  - a powder coating layer including a plurality of a finely divided, heat fusible material; and
  - a surface interface comprising a separate sealer coating applied thereon, wherein the surface interface is interposed between the first surface and the powder coating layer, wherein the surface interface consists essentially of inorganic filler in the form of a slurry or powder mixture comprising a cementitious material for modifying the first surface porosity and facilitates application of said powder coating layer to the substrate.